The analytical panel found that first sweetness was rceptible in the boiled squash, seasoned with 0.5 per-nt salt, 0.05 percent pepper and 1 percent butter. ter sweetness they tasted salt, a moderate amount of pper and butter, and finally the squash itself which s found to resemble sweet corn. In the sample con-ning the added glutamate, seasoned and tasted at the ne time, the outstanding quality was the blended aracter of the component notes, which is indicated by augmented size of the semi-circle and the reduction the outstanding notes. The order of perception of the vor components was not altered but another factor, uthfullness, was added.

Diagrammatic representations such as these profile awings are useful in gaining the understanding of rsons not versed in flavor techniques, for they are visual summaries and express fundamental concepts of flavor. These together with the tabular data sheets are valuable in providing management groups with a greater understanding of their own flavor problems and of the alternatives presented by research and production.

Inherent in any successful system of seasoning and flavoring is the building of an interesting complex of flavor. This is accomplished by the increase of blending, the building of greater amplitude, and the addition of interest factors. Such an approach allows for suppression of undesirable notes and augmentation of the desirable ones. This concept supplies a working scheme and philosophy to be followed in all problems of flavoring and seasoning. The Flavor Profile method is a means of indicating degrees of success in the development and control of optimum flavor.

Measuring the Firmness of Red Tart Cherries[a]

R. T. WHITTENBERGER

Eastern Regional Research Laboratory,[b] Philadelphia 18, Pennsylvania

AND

R. E. MARSHALL

Michigan Agricultural Experiment Station, East Lansing, Michigan

To determine the firmness of a sample of fresh red cherries, each of 20 cherries is compressed for 10 seconds between two flat surfaces by a force of approximately 300 grams. The results are expressed as average percent compression. The test is useful for measuring changes in firmness caused by bruising, cooling, soaking, and other treatments.

It is commonly considered that soaking red tart erries in cold water preliminary to commercial ocessing increases their firmness. The extent of the crease and the effect of various factors on firmness e, however, not adequately known, since observations firmness usually have been purely subjective. Dur-g recent studies on processing red cherries, the need r accurate data on firmness became apparent, and the ethod described below for measuring firmness was vised. The method involves compressing the whole sh fruit by a pressure tester developed at Michigan ate College,[c] and is somewhat similar to the methods nployed by Verner *(4)*, Haller et al. *(2)*, and Rose al. *(3)*, with other fruits. Comparable results on mpression of cherries may be obtained by using a modified Delaware jelly-strength tester *(1)* as a pressure tester. Most of the results obtained by the method will be published in detail in subsequent papers.

Apparatus

The essential features of the pressure tester are a stage on which the cherry is placed, and two flat-surfaced discs about 2 cm. in diameter between which the cherry is compressed (Figure 1). One of the discs (A) moves forward across the stage, while the second (B) remains fixed. The force acting on disc (A) originates from three coil springs, whose tension is adjustable. Disc (A) is released by a trigger mechanism, and its forward movement is shown by a pointer on a milli-

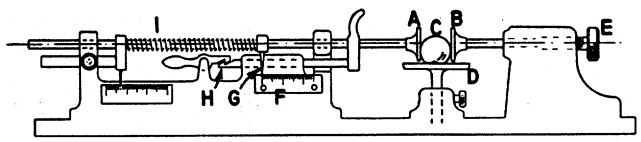

FIG. 1. Diagram of the essential parts of the pressure tester.

A. Disc (A), active. B. Disc (B). C. Specimen. D. Platform, adjustable. E. Screw adjustment for disc B. F. Millimeter scale. G. Pointer showing movement of disc A. H. Release for disc A. I. Compression spring, adjustable.

meter scale. The initial force exerted by disc (A) varies almost linearly from about 200 grams at a spring setting of 2.5 cm. (characteristic of this instrument) to about 700 grams at a setting of 7.0 cm. The effective force at an instrument setting of 3.5 cm. decreases about 15 percent as disc (A) advances 5 mm.

[a] Report of a study made under the Research and Marketing t of 1946.

[b] One of the laboratories of the Bureau of Agricultural and dustrial Chemistry, Agricultural Research Administration, ited States Department of Agriculture.

[c] The details of the pressure tester, which is adjustable for e with a wide variety of fruit and vegetable tissues, will be blished by G. J. Bouyoucos and R. E. Marshall.

Procedure

For determining the firmness of a lot of cherries, 20 fruits are taken at random, after the lot has been culled, and tested individually. The cherry (minus its stem) is placed on the stage with its stem end down and is oriented so that in its widest dimension it lightly touches disc (A). This orientation permits the compression of the maximum amount of flesh. Disc (B) is brought into contact with the side of the cherry opposite disc (A) by means of a screw adjustment. The maximum diameter of the cherry is determined by measuring with calipers the distance between the two discs. The initial force of disc (A) is adjusted to about 300 grams (instrument setting of 3.5 cm.). Next, disc (A) is released, and after approximately 10 seconds the amount of compression of the cherry is estimated to the closest one-tenth of a millimeter from the millimeter scale.

The data on the maximum diameters and on the compression of the 20 cherries each are averaged. From these two averages, the average percent compression of the cherries is calculated.

Discussion

It was necessary to evaluate the effects of several factors before arriving at a satisfactory procedure for measuring firmness. After measurement of cherries which varied widely in size, maturity, and extent of bruising, it was concluded that a force of 300 grams was near the optimum for covering the wide range in firmness. Forces moderately greater than 300 grams tended to mask small differences in firmness by compressing all specimens to approximately the same extent, whereas forces less than 300 grams did not yield a sufficiently high degree of compression in some specimens. The force was permitted to act for 10 seconds. In periods less than 10 seconds, the extent of compression was insufficient and the accuracy of reading from the millimeter scale was decreased, owing to the too rapid movement of the pointer.

The size of the cherry made a slight difference in the compression values, the largest cherries having the lowest values. For example, the largest 63 cherries (average diameter 20.9 mm.) from 9 different lots were compressed an average of 23.7 percent, whereas the smallest 63 cherries (average diameter 18.8 mm.) were compressed an average of 25.1 percent. Perhaps this result is associated with a shortcoming in the method. When cherries are compressed, the force acting on a unit volume of tissue is less in a large cherry than in a small one. Thus a large cherry tends to be compressed less than a small one, and appears to be firmer. It is probable, however, that the inherent firmness of tissue of small cherries is as great as or greater than that of large cherries.

Immature cherries were somewhat firmer than mature or over-mature cherries, and the firmness of all cherries varied inversely with the extent of their bruising and with the temperature. The test thus provides an objective means for determining the extent of bruising of cherries similar in size and maturity. Lowering the temperature from 21° to 1° C. increased the firmness of the cherries significantly (Table 1). The firmness of unsoaked cherries held at 1° C. increased steadily with time over a period of 12 days.

TABLE 1

Representative Data on the Compression of Montmorency Cherries

Treatment [d]	Average Diameter, mm.	Compression, Percent	Standard Error
Carefully picked; not bruised; not soaked			
1. Stored 2 hours at 21° C., tested at 21° C.	20.2	23.4	0.529
2. Stored 2 hours at 10° C., tested at 10° C.	19.9	21.5	0.560
3. Stored 2 hours at 1° C., tested at 1° C.	20.3	20.7	0.368
Difference required for significance at 5 percent level		1.4	
Commercially picked; bruised; tested at 27° C.			
4. Not soaked	19.1	28.0	0.718
5. Soaked 6 hours at 14° C.	19.3	27.4	0.633
6. Soaked 24 hours at 14° C.	19.4	23.8	0.414
Difference required for significance at 5 percent level		1.7	

[d] 20 cherries were used for each treatment.

The reliability of the test is indicated by the statistically treated data of Table 1. Usually the testing of 20 cherries from each lot (which required about 15 minutes) was adequate for revealing differences in firmness which would be of practical significance. However, if greater accuracy is desired, as is often the case in experimental studies, more than 20 cherries from each lot may be tested. Carefully picked and handled cherries were of fairly uniform firmness, and the standard error of measuring their percent compression was relatively low. For example, the difference in percent compression required for significance at the 5 percent level was 1.4 percent for the treatments outlined in Table 1. A greater difference (1.7 percent), however, was required for significance in commercially picked cherries (Table 1), owing principally to unequal bruising.

LITERATURE CITED

1. Baker, G. L. Improved Delaware jelly-strength tester. *Fruit Products J.*, 17, 329 (1938).
2. Haller, M. H., Harding, P. L., and Rose, D. H. The interrelation of firmness, dry weight, and respiration in strawberries. *Proc. Amer. Soc. Hort. Sci.*, 29, 330 (1932).
3. Rose, D. H., Haller, M. H., and Harding, P. L. Relation of temperature of fruit to firmness in strawberries. *Proc. Amer. Soc. Hort. Sci.*, 31, 429 (1934).
4. Verner, L. Experiments with a new type of pressure tester on certain stone fruits. *Proc. Amer. Soc. Hort. Sci.*, 27, 57 (1930).